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ELEMENTARY PRACTICAL PHYSICS.

Lessons in Elementary Practical Physics. By Balfour Stewart, M.A., LL.D., F.R.S., Professor of Physics, Victoria University, the Owens College, Manchester, and W. W. Haldane Gee, B.Sc., Demonstrator and Assistant Lecturer in Physics, the Owens College. Vol. II. Electricity and Magnetism (London: Macmillan and Co., 1887.)

THE second volume of the now familiar "Stewart and Gee" has at length appeared, and it is satisfactory to find that the hopes and expectations to which a just appreciation of the first has given rise have not been formed in vain, but that the same store of exact information down to the minutest details is to be found in "Electricity and Magnetism" as in "General Physical Processes."

While in this the second volume the authors "have adhered to the plan of subdivision into a series of lessons each descriptive of something to be done by a definite method with definite apparatus," they have treated the subject, to a certain extent, twice over—in the first three chapters generally, with simple and easily extemporized apparatus, and in the remaining chapters as exactly as possible, with all that care and attention to the details of standard patterns of instruments which are essential to the claim, in the title, of "practical." Thus in the second chapter instructions are given for measuring M and H by the method of Gauss without any bought apparatus, while in the sixth chapter is to be found a most complete description of the Kew unifilar magnetometer with figures of the instrument in its two positions and of its parts. There is here a fully worked example, from which a student who has not the advantage of using such an instrument may get an idea of the accuracy obtainable, and from which he may realize the relative importance of the numerous corrections which are applied. To facilitate the calculation of these corrections tables are supplied which will be of value to those using the magnetometer.

Though all will agree that a little practical introduction to the subject generally is of advantage to the student, and that therefore these three introductory chapters serve a really useful purpose, many will question the wisdom of devoting space in an essentially practical book to an explanation of such terms as electromotive force, conductivity, resistance, or of the theory of the battery or the meaning of Ohm's law. These are text-book matters for which a student does not depend on a practical book, nor is he expected to do so. The ten pages devoted to these points are in fact ten pages wasted.

The fourth chapter deals with the measurement of resistance. As this extends over 108 pages, and is divided into sixteen "lessons," it is clear that this very important branch of the subject receives its fair share of attention. The measurement of the resistance of every kind of material, from thick copper bars to insulators, is fully set forth. It is in this chapter that an explanation is given of the method of putting up a reflecting galvanometer and its several adjustments. The directions for fixing the instrument in the most perfect way are excellent. Not a word is said, however, to show that for many purposes such a galvanometer set up in any azimuth and almost anyhow is not less serviceable than when arranged as described. No trouble should be spared, and none is spared by the authors, in showing how to do anything which shall improve the accuracy of work done; but in some cases a mass of elaborate adjustment serves no purpose whatever, and then it should be pointed out that, though useful for this or that purpose, such adjustment may be dispensed with.

In the chapter on the tangent galvanometer the construction of standard and ordinary instruments is of course explained, and the method of using them. Their application to the determination of electro-chemical equivalents and of Joule's equivalent is given here. In the account of the method of finding the quantity of heat developed there is, apparently, a slight oversight. The authors speak of the mean deflection during the time the experiment lasts. If the current is practically constant, the mean deflection may be taken without appreciable error; but if it varies, then the square root of the mean square truly represents the heating effect of the current. It is true that it should be the aim of the experimenter to avoid such variations; but if for some reason they should occur, the student should be told how to make the best of his experiment.

In the sixth chapter, already referred to in part, we find a most admirable description of the methods of determining the magnetic elements. This chapter leaves nothing to be desired.

The chapter on electro-magnetic induction contains an account of a great many experiments on induction of magnetism by currents, of currents by currents, and of currents by magnets; but, as in the third chapter, space is devoted to matters which might with advantage be left to the ordinary text-books. For instance, there is no necessity to prove the expressions for the ballistic galvanometer, or to explain the theory of damping and logarithmic decrement. The determinations of the coefficients of self and mutual induction form the subject of one lesson only. This part may now with advantage be greatly extended, since, lately, Prof. Foster has brought the subject before the Physical Society, and many others have followed suit.

In the last two chapters the condenser and electrometer are treated.

A good deal of useful matter is to be found in some of the appendixes. In the first we find the Wheatstone net and Kirchoff's laws; in the second and third, the theory of the electrical units. The fourth will be found the most valuable, in the laboratory, as there is here much additional information on the comparison of electromotive forces and the construction of standard cells. That on additional practical details is useful as far as it goes.

There is nothing about electro-capillarity, or about instruments depending upon any action of the kind; there is practically nothing about the electro-dynamometer, and there is no index.

Though a few faults have been found, they are mostly unimportant; and it is a matter of opinion whether some, especially the introduction of theoretical explanations into a book intended for use in the laboratory, are faults at all. The book will be found to be of the

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greatest service in every physical laboratory, and to be a fitting companion to that already so well known. It is to be hoped that the remaining volume, on light, heat, and sound, will soon be ready.

THE ROYAL BOTANIC GARDEN, CALCUTTA.

Annals of the Royal Botanic Garden, Calcutta. Vol. I. The Species of Ficus of the Indo-Malayan and Chinese Countries; Part I. Palæomorphe and Urostigma. By George King, M.B., F.L.S., &c., Superintendent of the Royal Botanic Garden, Calcutta. (London: Reeve and Co., 1887.)

DR. KING deserves well of botanists for his protracted, though evidently profitable, labours on so varied and difficult a genus as *Ficus*. From obvious causes, a large proportion of the large arboreous tropical genera of plants are still very imperfectly known, and, prominent among them, *Ficus;* therefore Dr. King could hardly have extended his researches in a more useful direction. The present publication, which, from its general title, we may assume will not be limited to a monograph of the Asiatic species of *Ficus*, is a tall quarto of sufficient size to illustrate adequately almost all the species of the genus in question. Indeed, this monograph possesses a quite special value, inasmuch as every species is carefully figured in natural size, with enlarged analyses of the floral structure.

Most persons interested in such matters will be familiar with Fritz Müller and Solms Laubach's investigations of the sexual conditions in the flowers of various species of *Ficus*, and the singular phenomena attendant on the fertilization of the ovules. Nevertheless, it may be convenient to give here a brief account of the process.[1] The edible fig, which may be given as an example of the fruit of the genus generally, consists of a thick hollow receptacle, the inner surface of which is thickly studded with flowers; and, in the edible fig, exclusively with female flowers. Male flowers of this species of fig are borne on different plants, called the caprifig; and associated with these male flowers in the same receptacles are numerous female flowers, occupying the greater part of the space. Invariably these female flowers are infested by gall-producing insects, hence they are termed gall-flowers, and very rarely indeed is a single ripe seed found in a receptacle of the caprifig. The insects hatched and nourished in the gall-flowers leave the receptacles of the caprifig at a period when the pollen of the male flowers is being shed, and in making their exit bear some of it with them to the receptacles of the edible fig, which they next visit; but they are unable to deposit their eggs in the perfect females, and only serve to convey pollen to them. On similar mutual adaptations the fertilization of all the species of *Ficus* seems to depend.

In an introduction to the descriptive part of his work, Dr. King details the results of his own examination of several hundred species, extending over some nine years; and he states that Solms-Laubach anticipated him only in his explanation of the true nature of the "gall-flowers," for he had found them in every species of the genus that had come under his notice. He also enters into some further particulars concerning the insects acting in the process of fertilization, though he adds nothing more conclusive. While admitting, and even assuming, that the pollen of the males must be conveyed by the insects developed in the gall-flowers "to the perfect females imprisoned in the neighbouring receptacles," he is still puzzled as to the way in which it is done. We are under the impression that Solms-Laubach indicates, if he does not actually state in so many words, that he had not only frequently seen the winged female insect issuing from the receptacles of the caprifig, but that he had likewise occasionally observed them enter the receptacles of the cultivated fig, which is the female of the same species.

This, the first part of King's monograph, contains descriptions and figures of seventy-six species of *Ficus*, whereof ten belong to his section *Palæomorphe*, and the rest to *Urostigma*, which was originally proposed as an independent genus by Gasparrini, and provisionally retained as such by Miquel. King found five different kinds of flower, variously associated or removed, in the Asiatic species of fig; and upon characters derived from the differentiation and arrangement of the sexual organs he classifies the species in two primary groups and seven sections. The species of the relatively small group *Palæomorphe* are distinguishable from all the others by having spuriously bisexual flowers associated with gall-flowers, while the fertile females occupy separate receptacles. In the definitions of the sections, the pistil in the functionally male flowers is described as rudimentary, though perhaps sterile would be a better term to use, because, as figured, and designated in the explanations of the figures, it is a fully-developed gall-pistil. This condition is regarded as the nearest approach to assumed original complete hermaphroditism.

In all six sections of the larger group the sexes are strictly separated, as to the individual flowers; and in the section *Urostigma*, male, gall, and perfect female flowers are intermingled in the same receptacles. We have overlooked it if there is any explanation of the advantage derivable from the presence of gall-flowers where both sexes are also found in the same receptacle; but it may, perhaps, be found in the fact that the inflorescence is proterogynous or proterandrous, hence insect agency is as necessary as in those species where the sexes are in different receptacles.

In the remaining five sections the male and gall-flowers are invariably borne in one set of receptacles, and the fertile female flowers in another set; and the presence of neuter flowers in the female receptacles characterizes the section *Synœcia*. The neuter flowers contain rudiments of neither sex, which condition King explains by saying the neuter flowers are asexual.

Neuter flowers are wanting in the sections *Sycidium*, *Covellia*, *Eusyce*, and *Neomorphe*; but the arrangement of the flowers is otherwise the same as in *Synœcia*. The two first of these sections have monandrous male flowers, and the two last have diandrous or triandrous male flowers: while the receptacles of the first and third are mostly axillary, those of the second and fourth are usually borne in fascicles on the stem and branches. Thus it will be perceived that the distinctive characters of these four sections are somewhat artificial. However, it is only fair to say that the author himself points out this fact.

[1] Further details will be found in NATURE, vol. xxvii. p. 584.

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